Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

Reserve
aS21
.A75U53

EFFECTS OF AIRFLOW RATES ON THE DRYING AND QUALITY OF GREEN PEANUTS IN DEEP BEDS

ARS-S-135

August 1976

U.S. DEPT. OF AGRICULTURE
NAT'L AGRIC. LIBRARY
RECEIVED

SEP 1 '76

PROCUREMENT SECTION
CURRENT SERIAL RECORDS

AGRICULTURAL RESEARCH SERVICE • U.S. DEPARTMENT OF AGRICULTURE

677860

CONTENTS

Page
Abstract 1
Introduction 1
Materials and methods 2
Results 2
    Average drying rate 2
    Milling quality and germination 4
    Food-quality parameters 4
Discussion 5
Literature cited 5

ILLUSTRATIONS

Fig.
1. Schematic of bin dryer used in tests 2
2. Average drying rates of Spanish peanuts in 1970 2
3. Average drying rates of Runner peanuts in 1970 3
4. Average drying rates of 'Virginia 65R' peanuts in 1970–71 3
5. Average drying rates of 'Florigiant' peanuts in 1971 3
6. Average drying rates of Runner peanuts in 1971 3
7. Blanchability of Spanish peanuts dried in 1970 4
8. Hunter *L* color values for peanut butter made from Spanish peanuts dried in 1970 5
9. Hunter *aL* color values for peanut butter made from Spanish peanuts dried in 1970 5

TABLES

1. Average split-kernel outturn and germination of peanuts dried in 1970–71 3
2. Mean values of food-quality parameters for peanuts dried in 1970–71 4

ACKNOWLEDGMENTS

This work was conducted under the general supervision of Reed S. Hutchison and Charles E. Holaday, research leaders, National Peanut Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Dawson, Ga.

2578711

EFFECTS OF AIRFLOW RATES ON THE DRYING AND QUALITY OF GREEN PEANUTS IN DEEP BEDS

By Paul D. Blankenship and Jack L. Pearson[1]

ABSTRACT

Spanish, Runner, and Virginia peanuts were dried at airflow rates ranging from 11 to 60 ft^3/min/ft^3 of peanuts with air temperatures kept at 95° ± 5°F to determine the effects of airflows on the drying rates and quality of green peanuts in deep (3-ft) beds. Average drying rates increased with increases in airflow, but milling quality, as determined by a commercial sheller, was not significantly affected. Germination showed no consistent trends, but some of the Virginia peanuts dried at lower airflow rates had significantly higher germinations than peanuts dried at higher airflow rates. Airflow rates slightly affected some food-quality factors, including a decrease in the blanchability of Spanish peanuts (1.31 percentage points) when the rate of flow was increased from 13.8 to 39.2 ft^3/min.
KEY WORDS: airflow rates, drying, food quality, germination, milling quality, peanuts.

INTRODUCTION

Artificial peanut drying became important with the application of mechanized harvesting in the 1950's. Currently, most peanuts are dried in windrows to a moisture content of about 20 percent and are then artificially dried in bulk to a moisture content of 10 percent (or less) for safe storage. Recent developments in harvesting technology and equipment have reduced windrow drying time and have provided for a shorter harvest. Also, a trend toward one-variety planting has narrowed the harvest span. Consequently, the need for faster artificial drying has become more important.

Butt and Kummer (*4*)[2] studied the effects of two airflow rates (8.83 and 15.86 ft^3/min/ft^3 of peanuts) on the drying rates of peanuts in 18-inch deep beds and found that the higher airflow rate dried the peanuts faster. Baker et al. (*1*) studied the effects of drying peanuts with a moisture content of 35 percent in 3.5-foot-deep beds with airflows up to 18 ft^3/min/ft^3 of peanuts and found that drying rates increased with increases in airflow. Person and Sorenson (*5*) dried peanuts having 28 and 25 percent moisture to a moisture content of 10 percent with airflows ranging from 8 to 20 ft^3/min/ft^3 of peanuts and found that drying times and fuel efficiency decreased with increased airflow rates. Beasley and Dickens (*2*) showed the effects on milling quality and drying rates of green peanuts dried in thin layers with airflows up to 120 ft^3/min/ft^2. They predicted that the use of high airflow rates for drying peanuts in deep beds would not increase the tendency of peanuts to split or skin during the shelling operation.

The purpose of this research was to determine the effects of airflow rates on the drying and quality of green peanuts in deep (3-ft) beds. This work was similar to that conducted by Baker

---

[1] Agricultural engineer and research horticulturist, National Peanut Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Dawson, Ga. 31742.

[2] Italic numbers in parentheses refer to items in "Literature Cited" at the end of this publication.

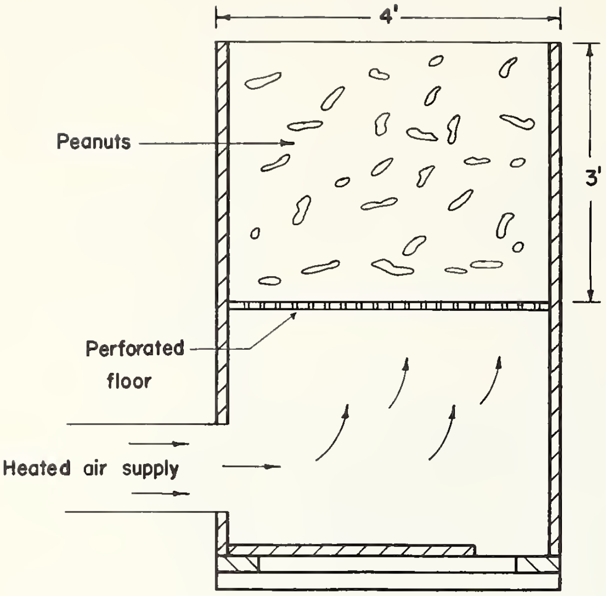

FIGURE 1.—Schematic of bin dryer used in tests.

et al. (*1*) except that higher airflow rates were used in these tests and the peanut lots were 31 times larger in volume. Also, a more accurate method of determining milling quality was used.

MATERIALS AND METHODS

This study was conducted at Agricultural Research Service's National Peanut Research Laboratory, Dawson, Ga., and at a field station in Suffolk, Va., in 1970–71. 'Starr' (Spanish), 'Early Runner' and 'Florunner' (Runner), and 'Florigiant' (Virginia) peanuts were used in the Dawson tests, whereas only 'Virginia 56R' (Virginia) peanuts were used in the tests at Suffolk.

Peanuts for all tests were picked with a combine immediately after digging with a mechanical digger shaker and were then transported to the drying stations and cleaned. Then the peanuts were divided into test samples (48 ft^3) and placed in bin dryers (4 ft by 4 ft by 3 ft), where they were dried in duplicate tests during a 2-week period (each year) at airflow rates ranging from 11 to 60 $\text{ft}^3/\text{min}/\text{ft}^3$ of peanuts (fig. 1). The drying-air temperature was maintained at 95° ± 5° F for all tests.

After drying to an average moisture content of 10 percent, the peanuts in each test sample were again cleaned and divided into subsamples for shelling and germination tests. In addition, a total of approximately 50 to 60 pounds of peanuts was collected from each test sample of Spanish peanuts in 1970 and Virginia (Dawson) peanuts in 1971 for food-quality tests. The peanuts from each sample for the shelling tests were placed in burlap bags and stored 4 to 6 weeks for moisture equalization before shelling. Milling quality was determined by shelling the peanuts in the pilot shelling plant at Dawson, which employs full-size commercial shellers. Split-kernel outturn was considered the primary indicator of milling quality for these tests.

Six food-quality evaluations and germination were determined by the procedures described by Blankenship and Pearson (*3*). The food-quality parameters are raw-kernel color (measured in terms of Hunter *L* and *aL* values), peanut butter color (*L* and *aL* values), blanchability, and flavor.

RESULTS

Average Drying Rate

The average drying rate (percentage of moisture content loss per hour) of the peanuts in the tests varied directly with the airflow rate—the higher the airflow rate, the higher the average drying rate. The average drying rates of the Spanish and Runner peanuts dried in 1970 are shown in figures 2 and 3. The average drying rate of the Spanish peanuts increased 0.19 percentage points through the range of airflow rates; Runner peanuts increased 0.28 percentage points. The average drying rates of the 'Virginia 65R' peanuts are shown in figure 4. Peanuts dried with airflows of 12 and 20

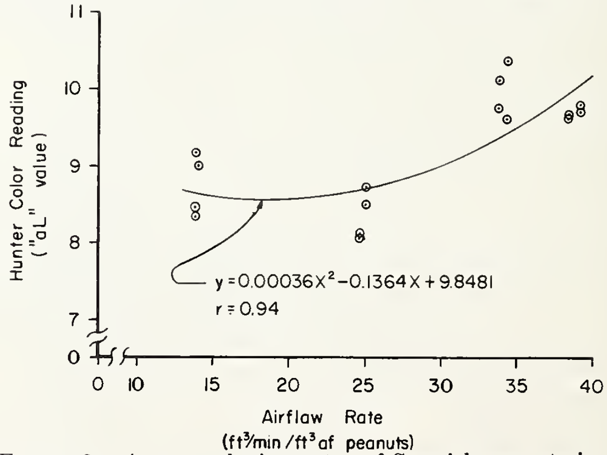

FIGURE 2.—Average drying rates of Spanish peanuts in 1970.

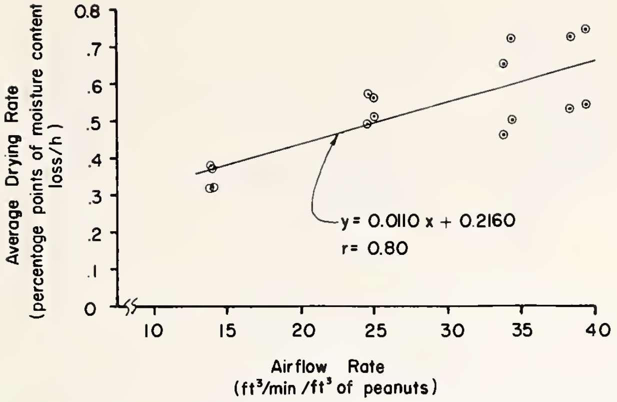

FIGURE 3.—Average drying rates of Runner peanuts in 1970.

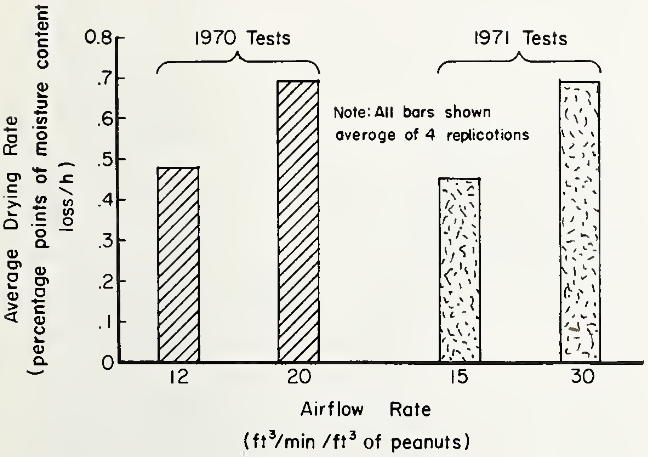

FIGURE 4.—Average drying rates of 'Virginia 65R' peanuts in 1970–71.

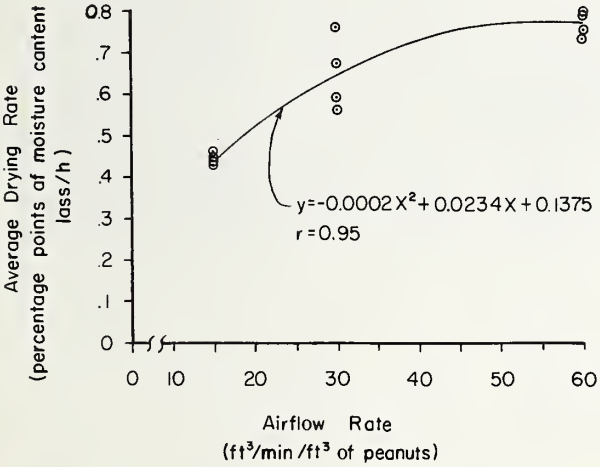

FIGURE 5.—Average drying rates of 'Florigiant' peanuts in 1971.

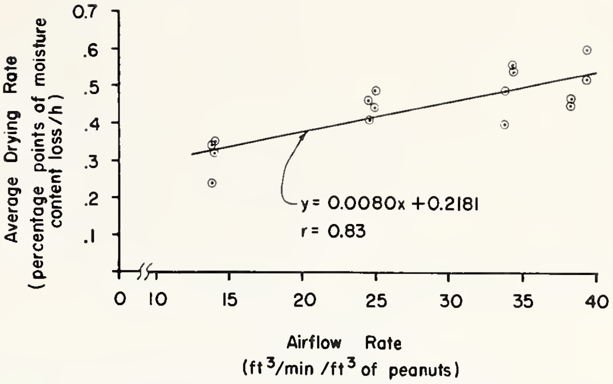

FIGURE 6.—Average drying rates of Runner peanuts in 1971.

TABLE 1.—*Average split-kernel outturn and and germination of peanuts dried in 1970–71*[1]

Peanut type	Airflow rate (ft³/min)	Split-kernel outturn[2] (percent)	Germination[2,3] (percent)
		1970 tests	
Spanish (Dawson)	14	3.45	86.90
Do	25	3.93	84.12
Do	34	3.68	85.23
Do	39	3.43	76.78
Runner (Dawson)[4]	14	5.75	50.88
Do	25	5.88	47.93
Do	34	5.70	49.87
Do	39	6.15	49.73
Virginia (Suffolk)	12	6.58	82.95a
Do	20	6.63	77.95b
		1971 tests	
Virginia (Dawson)	15	4.70	45.83a
Do	30	4.73	36.15b
Do	60	4.18	33.86b
Runner (Dawson)[5]	15	2.40	47.30
Do	30	2.33	52.60
Do	60	2.63	51.28
Virginia (Suffolk)	15	12.90	.....
Do	30	12.18	.....

[1] Drying-air temperature maintained at 95°±5° F during all tests.

[2] Each entry is the average of 4 tests at each airflow rate—2 tests the 1st week and 2 tests the 2d week.

[3] Averages within the same peanut group followed by unlike letters are significantly different at the 0.05 level.

[4] 'Early Runner' used in tests the 1st week; 'Florunner' used the 2d week.

[5] 'Florunner' used in all tests.

ft^3/min differed by an average of 0.21 percentage points. The effects of the airflows on the average drying rates of the Virginia and Runner peanuts in Dawson in 1971 are shown in figures 5 and 6. The average drying rate of the Virginia peanuts increased 0.32 percentage points as airflow increased from the lowest to the highest rate; Runner peanuts increased 0.21 percentage points. The average drying rates obtained from the two airflows used on 'Virginia 65R' peanuts in Suffolk differed by an average of 0.24 percentage points (fig. 4).

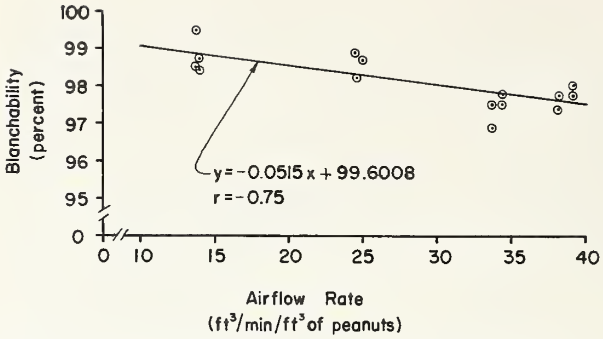

FIGURE 7.—Blanchability of Spanish peanuts dried in 1970.

Milling Quality and Germination

The average percentages of split-kernel outturn and germination for each type of peanut dried during the tests in 1970–71 are presented in table 1. Increasing the average drying rates with higher airflow rates did not significantly affect the split-kernel outturn. Drying at different airflow rates had no significant effect on the germination of the Spanish and Runner peanuts. Some of the Virginia peanuts (Suffolk —1970; Dawson—1971) dried at the lower airflow rates had significantly higher (0.05 level) germination than the peanuts dried at the higher airflow rates.

Food-Quality Parameters

Means of the food-quality parameters for the airflow rates for both Spanish and Virginia (Dawson) peanuts are shown in table 2. Blanchability and peanut butter color for the Spanish peanuts were the only food-quality parameters significantly affected by the test treatments.

The effect of the airflows on the blanchability of the Spanish peanuts is shown in figure 7. Increasing the airflow from 13.8 to 39.2 ft^3/min decreased the blanchability of these peanuts 1.31 percentage points.

Color differences produced in the peanut butter made from Spanish peanuts are shown in figures 8 and 9. Values for the lowest airflow approximated USDA comparator No. 2 for peanut butter, and values for the highest airflow approximated comparator No. 3. The Hunter *L* color value for the peanuts decreased 3.26

TABLE 2.—*Mean values of food-quality parameters for peanuts dried in 1970–71*[1]

Peanut type	Airflow rate (ft^3/min)	Raw kernel color *L*	Raw kernel color *aL*	Blanchability (percent)	Peanut butter color *L*	Peanut butter color *aL*	Flavor rating[2]
				1970 tests[3]			
Spanish	14	43.56	13.21	98.79a	50.44a	8.75a	2.33
Do	25	44.34	13.38	98.65a	51.41a	8.36a	2.60
Do	34	44.22	13.15	97.45b	47.68b	9.97b	2.48
Do	39	43.84	13.16	97.78b	48.20b	9.72b	2.43
				1971 tests			
Virginia (Dawson)	15	43.64	14.07	99.42	51.94	7.55	2.50
Do	30	43.46	13.95	99.29	51.47	7.86	2.93
Do	60	43.62	13.95	99.39	51.43	7.80	3.03

[1] Analyses by Duncan's new multiple-range test. Color evaluations made per Hunter *L* and *aL* values.

[2] 1, excellent. 2, good. 3, fair. 4, poor. 5, very poor.

[3] Means in the same column followed by unlike letters are significantly different at the 0.05 level.

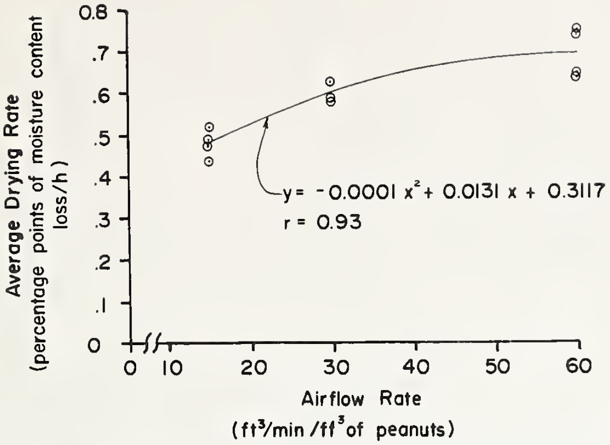

FIGURE 8.—Hunter *L* color values for peanut butter made from Spanish peanuts dried in 1970.

points between airflows of 13.8 and 39.2 ft³/min (fig. 7); however, the *aL* value increased 1.38 points (fig. 8). Thus, the peanuts dried by the highest airflow produced a slightly darker and redder peanut butter than did the peanuts dried by the lowest airflow. A slightly shorter roasting time or lower roasting temperature for the peanuts dried by the highest airflow would probably have produced a peanut butter color similar to that of the peanuts dried by the lowest airflow.

DISCUSSION

Generally, the drying rates of the peanuts in these tests increased with increases in airflow but with little effect on peanut quality. Only slight variations were produced in the quality parameters of germination, blanchability, and peanut butter color.

Using high airflow rates to increase peanut-drying rate may not always be economical because of increased fuel requirements and because fan horsepower increases mathematically as the cube of the volume of air delivered. The amount of increase in drying rate may not justify the increase in power and fuel consumption. However, to avoid overloading the drying facility when a rush period is imminent or to prevent crop losses when bad weather is threatening, the dryer operator may be able to justify using higher airflow rates to increase the overall drying rate.

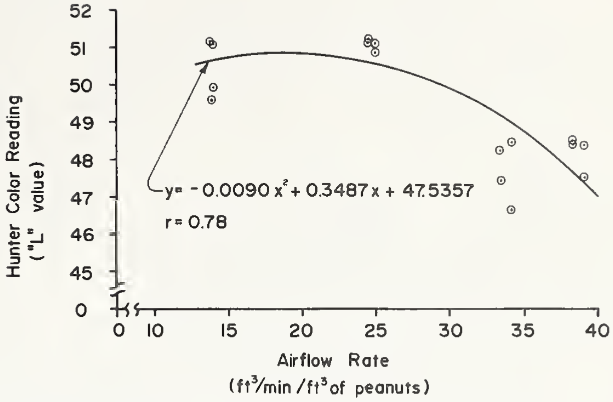

FIGURE 9.—Hunter *aL* color values for peanut butter made from Spanish peanuts dried in 1970.

It should also be emphasized that the peanuts dried in these tests were dried in the "green" state. Peanuts dried in a semigreen state would probably show smaller increases in drying rates for the corresponding airflow rates than those shown in these tests.

LITERATURE CITED

(1) Baker, V. H., Cannon, B. M., and Stanley, J. M. 1952. A continuous drying process for peanuts. Agric. Eng. 33(1): 351–356.

(2) Beasley, E. O., and Dickens, J. W. 1963. Engineering research in peanut curing. N.C. Agric. Exp. Stn. Tech. Bull. 155, 38 pp.

(3) Blankenship, P. D., and Pearson, J. L. 1974. Effects of restoring peanut moisture with aeration before shelling. Peanut Sci. 2(1): 6–11.

(4) Butt, J. L., and Kummer, F. A. 1951. Artificial curing of peanuts. Agric. Eng. 32(1): 27–30.

(5) Person, N. K., Jr., and Sorenson, J. W., Jr. 1974. Effect of design airflow of peanut dryers on the drying time and fuel consumption. ASAE Paper No. 74-3526, 15 pp.

* - 1976-G.P.O.-1750-S/671-583/80

U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
SOUTHERN REGION
P. O. BOX 53326
NEW ORLEANS, LOUISIANA 70153

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF
AGRICULTURE
AGR 101

U.S.MAIL